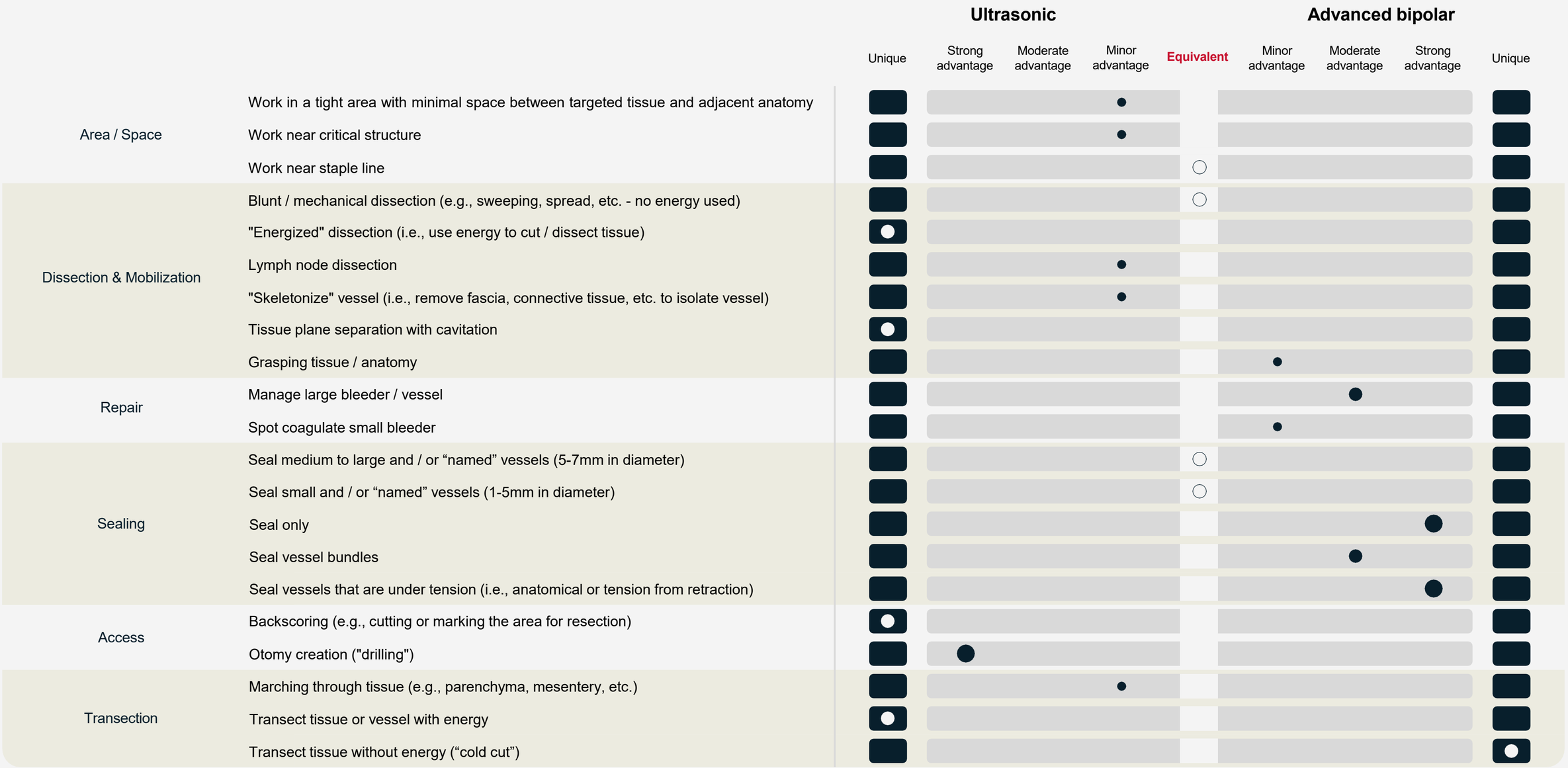
Best Energy for the Surgical Task

Johnson&Johnson
MedTech

Best Energy for the Surgical Task



Note: These are general guidelines. Each surgeon and situation is unique.

Work in a tight area with minimal space between targeted tissue and adjacent anatomy

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Ultrasonic

Clinical examples & considerations - Working in confined spaces or near a critical structure requires precision.

Head & Neck: Thyroid dissection with parathyroid preservation **Colorectal:** Total mesorectum excision with sacral nerve plexus preservation; IMA / lymph node complex dissection **Gynecology:** TLH with rectum and bladder release **Thoracic:** Mediastinal lymphadenectomy

Ultrasonic technology

Advantages

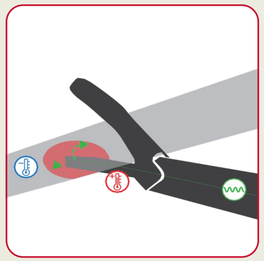
- Delivers energy precisely to targeted tissue using frictional heat.
- Steam production is lower & believed to be cooler than advanced bipolar.[1]
- There is no stray, or radiated, electrical energy flowing into tissue.
- 1.5mm of lateral thermal spread[2]*
- Thin, tapered blade design

Trade-offs

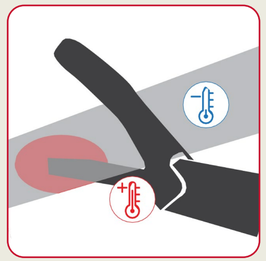
- Blade is hotter (vs. advanced bipolar) & retains heat longer[3].

Science of energy

Creating heat from friction – ultrasonic technology converts electrical energy to mechanical motion.



Mechanical energy simultaneously coagulates, seals and transects **via friction** of the blade on tissue.



Heat from friction s**tarts in the blade** and extends into the tissue, making the **blade hotter than the targeted tissue.**

Example of blade design

Thin and tapered.

Advanced bipolar technology

Advantages

- Jaws are cooler (vs. ultrasonic blade) and cool down faster[3]
- Minimal lateral thermal spread (<2mm)[2*]

Trade-offs

- Electrical energy heats and boils intracellular fluids, which increases resistance and can cause electricity to radiate outside of the jaws.
- Steam production is greater and believed to be hotter than ultrasonic technology.[1]

Example of blade design

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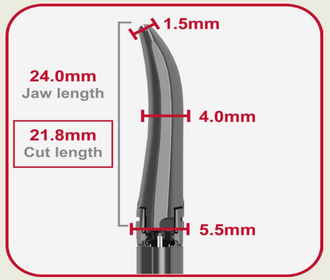
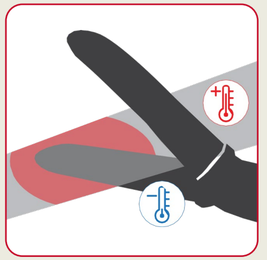
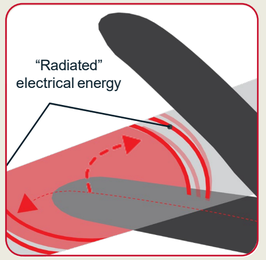


Science of energy

Creating heat from electricity – electricity is passed between electrodes of the jaw and boils intracellular fluids – heating starts in the tissue.



Heat generated in tissue extends to the device, making the **tissue hotter than the device.**



Radiated electrical energy can flow outside of the jaws of the device because of increasing resistance from tissue desiccation.

*HAR736 tested in vivo, porcine carotid. MAX mode at power level 5 used for vessels up to 2mm in diameter. MIN mode at power level 3 used for vessels larger than 2mm up to 5mm in diameter. Measured via histopathology.

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Work near critical structure

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Ultrasonic

Clinical examples & considerations - Working in confined spaces or near a critical structure requires precision.

Head & Neck: Thyroid dissection with parathyroid preservation **Colorectal:** Total mesorectum excision with sacral nerve plexus preservation; IMA / lymph node complex dissection **Gynecology:** TLH with rectum and bladder release **Thoracic:** Mediastinal lymphadenectomy

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  - There is no stray, or radiated, electrical energy flowing into tissue
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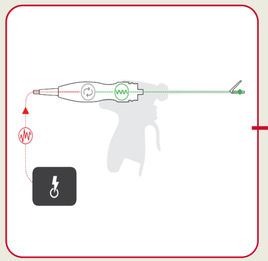
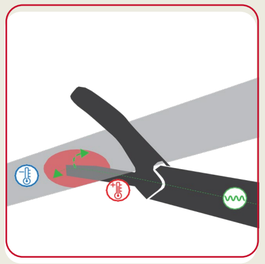
Science of energy

Creating heat from friction



Ultrasonic technology converts electrical energy to mechanical motion.



Mechanical energy simultaneously coagulates, seals and transects **via friction** of the blade on tissue.

Blade design

Thin and tapered.

Advanced bipolar technology

Advantages

- Jaws are cooler (vs. ultrasonic blade) and cool down faster[3]
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Blade design

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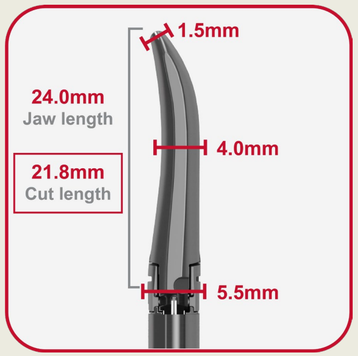
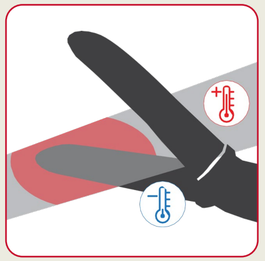


Science of energy

Creating heat from electricity



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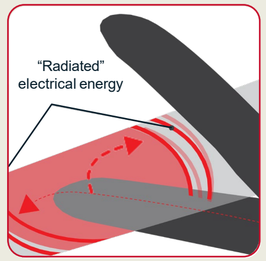

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Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Work near staple line

Back to matrix

Advantage: NONE - modalities are equal

Ultrasonic = Advanced bipolar

Clinical examples & considerations

Two fundamental rules to keep in mind: Avoid transmitting (1) electric current and (2) vibration to the staples. Ultrasonic allows touch ups to control oozing and bleeding of small vessels along the staple line. Advanced bipolar can be useful in the preparation of anastomoses.

Ultrasonic technology

Advantages

- No electricity passes between the jaws or through the patient.
- No risk of electrical arcing or sparking.

Trade-offs

- Risk of blade breakage with some ultrasonic devices if used directly on a staple / staple line.

Science of Energy

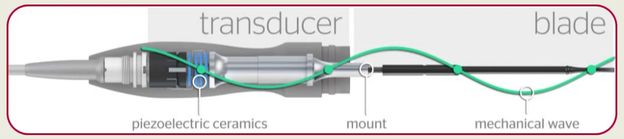
Converting electrical energy to mechanical motion

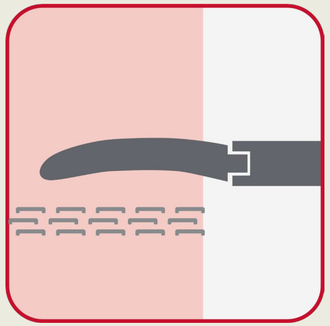
Ultrasonic technology converts electrical energy to mechanical motion to create frictional heat to create the tissue effect.

No risk of sparking or arcing as zero electricity is generated.

Worth knowing

The active blade will only become hot from friction when in contact with something (e.g., tissue, fluid, clamp arm pad, etc.)





Advanced bipolar technology

Advantages

- No risk of breaking end-effector.
- No electrical arcing or sparking.

Trade-offs

- Will not deliver energy when on a staple (generator will show error message to reposition device on tissue), which can cause frustration if the surgeon is not aware of the staple between the jaws.

Science of Energy

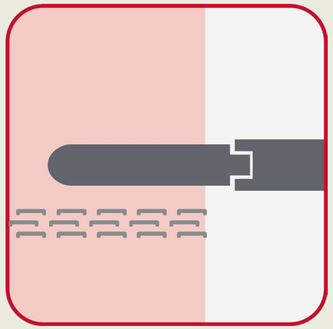
Creating heat with electrical energy

With tissue between the jaws, electrical energy passes from an active electrode to a return electrode, heating intracellular fluids to create tissue effects.

Arcing or sparking will not occur when not in direct contact with a staple. Most advanced bipolar devices will not deliver energy when directly on a staple (e.g., GEN11 generator will show error message to “Reposition jaws and reactivate”).

Worth knowing

Electricity will not flow without tissue between the jaws (tissue is needed to complete the circuit)



Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Blunt / mechanical dissection (e.g., sweeping, spread, etc. - no energy used)

Back to matrix

Advantage: NONE - modalities are equal

Ultrasonic = Advanced bipolar

Clinical examples & considerations

Colorectal: Previous peritonitis, diverticulitis, IBD, multiple laparotomies **Thoracic:** Empyema, pleuritis **Gynecology:** Recurrent salpingitis, vaginal fistulas **Head & Neck:** Tumors, previous infection or abscesses

Ultrasonic technology

Advantages

- Tend to have a finer and more tapered distal tip vs. advanced bipolar devices (varies between manufacturer designs).

Trade-offs

- Fixed blade position does not provide bilateral jaw movement (i.e., only the clamp arm moves).

Advanced bipolar technology

Advantages

- Some advanced bipolar devices have a distal tip specifically designed to enable dissection.
- Advanced bipolar device can have either unilateral or bilateral jaw movement (varies between manufacturer designs).

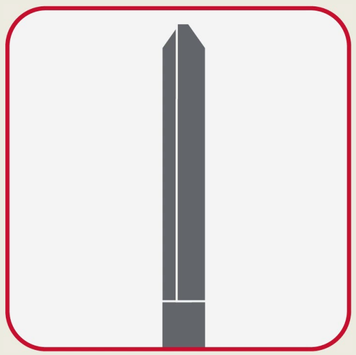
Trade-offs

- Tend to have a broader distal tip vs. ultrasonic (varies between manufacturer designs).

Example of distal tip jaw configuration

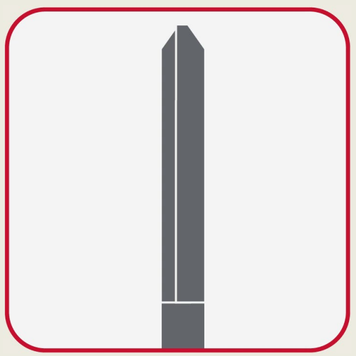
Ultrasonic[4]

Fixed blade/electrode configuration



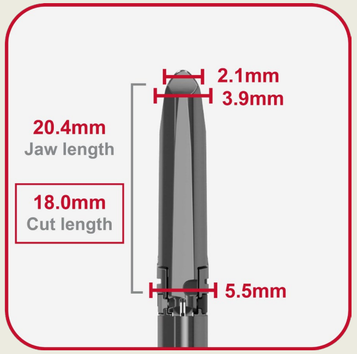
Found on all ultrasonic devices, and some advanced bipolar devices.

Bilateral blade configuration



Found on some advanced bipolar devices.

Advanced bipolar[5]



Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

"Energized" dissection (i.e., use energy to cut / dissect tissue)

Back to matrix

Unique capability for

Ultrasonic

Clinical examples & considerations

Especially applicable to abdominal surgeries on releasing large areas.

Colorectal: Colonic detachment, omentectomy, mesentery dissection **Gynecology:** Total abdominal hysterectomy (TAH), debulking in ovarian cancer

Ultrasonic technology

Advantages

- Simultaneous coagulation and cut (enables efficiency).
- Efficient and quick tip nibbling.
- Allows back-scoring.
- Tissue plane separation via cavitation.
- Tend to have a finer and more tapered tip vs. advanced bipolar devices (varies between manufacturer designs).
- Narrower thermal footprint (blade widths are typically narrower than advanced bipolar devices).

Trade-offs

- Blade is hotter (vs. advanced bipolar) and retains heat longer[3]
- Fixed blade position does not provide bilateral jaw movement (i.e., only the clamp arm moves).

Advanced bipolar technology

Advantages

- NOTE: Using energy to cut is a unique feature of ultrasonic technology. But some surgeons who use advanced bipolar will often consider dissection with advanced bipolar technology as “energized” due to the use of energy to coagulate prior to cutting with the knife blade.
- Some advanced bipolar devices have a distal tip specifically designed to enable dissection.
- Advanced bipolar device can have either unilateral or bilateral jaw movement (varies between manufacturer designs).
- The jaws are cooler (vs. ultrasonic blade) and cool down faster[3]

Trade-offs

- Requires a minimum of 2 steps: energy delivery, followed by transection with knife.
- Does not cut to the distal tip (knife stops at ~1-2mm before tip).
- Wider thermal footprint causes more damage (electrode widths are typically wider than ultrasonic blades).

Efficient dissection

While all advanced energy devices with a clamp can perform dissection, ultrasonic devices are unique in their ability to simultaneously coagulate and cut, making dissection tasks more efficient.

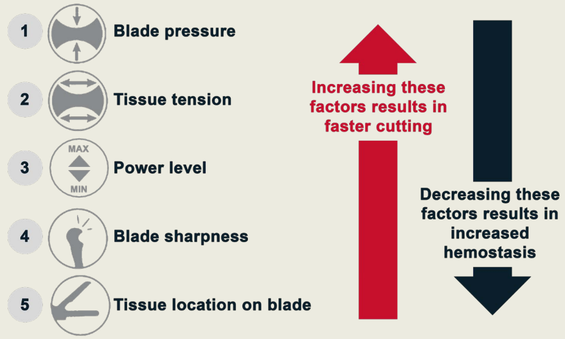
Dissection

Backscoring (unique to ultrasonic)

Cavitation (unique to ultrasonic)

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic



Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Lymph node dissection

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Ultrasonic

Clinical examples & considerations

Examples of challenging lymphadenectomies:

Oncology: Esophagus, stomach, pancreas, and bile ducts **Gynecology:** Uterus and cervix **Zones:** Retroperitoneal, mediastinal, inguinal, and axillary

Ultrasonic technology

Advantages

- Efficient and quick tip nibbling.
- Tend to have a finer and more tapered tip vs. advanced bipolar devices (varies between manufacturer designs).
- Narrower thermal footprint (blade widths are typically narrower than advanced bipolar devices).

Trade-offs

- Blade is hotter (vs. advanced bipolar) and retains heat longer.[3]
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Ultrasonic dissection

Efficient dissection

While all advanced energy devices with a clamp can perform dissection, ultrasonic devices are unique in their ability to simultaneously coagulate and cut, making dissection tasks more efficient.

HARMONIC™ 1100 Shears[4]

Advanced bipolar technology

Advantages

- Some advanced bipolar devices have a distal tip specifically designed to enable dissection.
- The jaws are cooler (vs. ultrasonic blade) and cool down faster.[3]
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Trade-offs

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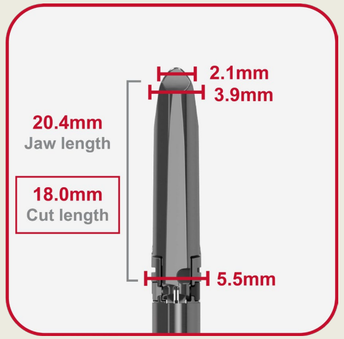
Fine tapered end-effectors facilitate dissection

Cut lengths are comparable between some ultrasonic and advanced bipolar devices.
Note the advanced bipolar cut length is shorter than the overall jaw length.

ENSEAL™ X1 Curved Jaw[5]



ENSEAL™ X1 Straight Jaw[5]

Key differentiating advantage(s).
Note: These are general guidelines. Each surgeon and situation is unique.

"Skeletonize" vessel (i.e., remove fascia, connective tissue, etc. to isolate vessel)

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Ultrasonic

Clinical examples & considerations - Generally, 3 situations determine the skeletonization of a vessel:

- Correct identification of the anatomy: seal the branch of the target structure.
- Release of fibrosis: especially after inflammation and radiotherapy.
- Dissection and removal of the proximal lymph nodes that drain the tumor.

This maneuver allows for individual gripping and sealing of the vessel and is typically reserved for specific cases, as it requires dexterity and skill.

Ultrasonic technology

Advantages

- Enables efficient tip nibbling.
- Tissue plane separation via cavitation.
- Tend to have a finer and more tapered tip vs. advanced bipolar devices (varies between manufacturer designs).
- Narrower thermal footprint (blade widths are typically narrower than advanced bipolar devices).

Trade-offs

- Blade is hotter (vs. advanced bipolar) and retains heat longer.[3]
- Fixed blade position does not provide bilateral jaw movement (i.e., only the clamp arm moves).

Ultrasonic dissection

Efficient dissection

While all advanced energy devices with a clamp can perform dissection, ultrasonic devices are unique in their ability to simultaneously coagulate and cut, making dissection tasks more efficient.

HARMONIC™ 1100 Shears[4]

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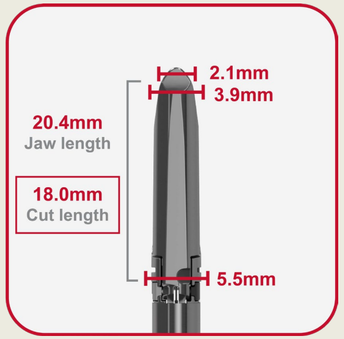


ENSEAL™ X1 Straight Jaw[5]

Key differentiating advantage(s).
Note: These are general guidelines. Each surgeon and situation is unique.

Tissue plane separation with cavitation

Back to matrix

Unique capability for

Ultrasonic

Clinical examples & considerations

Cavitation is especially useful in dissecting the peritoneum and mesentery, as well as the soft tissues of the neck and mediastinum.

Ultrasonic technology

Advantages

Cavitation effect from blade displacement at the distal tip provides quick tissue plane separation.

Trade-offs

- Requires some practice / expertise.
- Hot blade requires care to not inadvertently damage surrounding structures.

Using the cavitation effect at the tip of the blade to separate tissue planes.

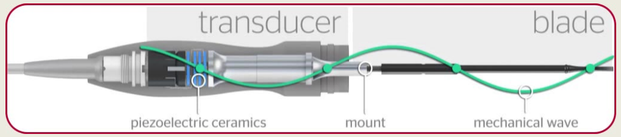
What is Cavitation?

Cavitation is the formation of expanding and collapsing vapor bubbles in a liquid when ultrasound is applied. With ultrasonic devices, cavitation occurs primarily at the tip of the device.

Science of energy - How cavitation is created

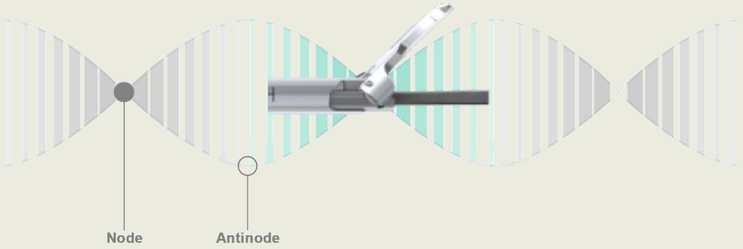
Converting electrical energy to mechanical motion

Electrical energy from the generator is converted to mechanical motion in the hand piece transducer. This movement cycles 50,000 to 55,500 times per second to create frictional heat when in contact with tissue.



Expansion and contraction of the blade

The mechanical wave travels down the entire length of the blade, causing the titanium shaft to expand and contract in between the nodes. The greatest displacement occurs at the antinodes. Note that the distal tip is designed to be at an antinode.



Distal tip displacement

~50 µm at Power Level 1
~100 µm at Power Level 55

1,000µm = 1mm

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Grasping tissue / anatomy

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Advanced bipolar

Clinical examples & considerations

Tissues must be handled delicately, especially the hollow viscera, pancreas, thyroid, ovary, and lung. The wider and smoother the jaw, the lower the risk of injury, e.g., abdominal distension, multi-quadrants abdominal procedures, dissection in sites of inflammation.

Colorectal: Irritable Bowel Disease (IBD), diverticulitis **Gynecology:** Endometriosis **Thoracic:** Lung debridement

Ultrasonic technology

Advantages

- Clamp arm provides grasping capabilities.

Trade-offs

- Blade and clamp arm have a narrower width (varies between manufacturer designs) vs. advanced bipolar devices.
- Blade heat and heat retention can be a concern if grasping tissue immediately following activation.

Advanced bipolar technology

Advantages

- Jaw width is wider than ultrasonic, allowing more tissue to be grasped at a time.
- The jaws are cooler (vs. ultrasonic blade) and cool down faster (vs. ultrasonic technology), allowing surgeon to grasp more tissue sooner after energy activation.
- Clamp arm provides grasping capabilities.

Trade-offs

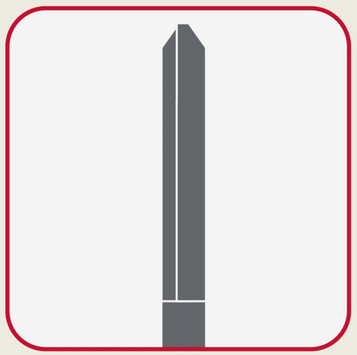
- N/A

Distal tip jaw configurations

Ultrasonic[4]

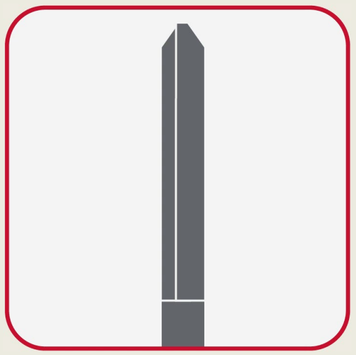
HARMONIC™ 1100 Shears

Fixed blade / electrode configuration



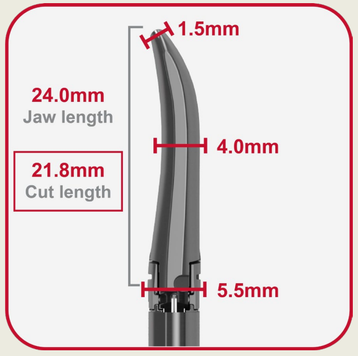
Found on all ultrasonic devices, and some advanced bipolar devices.

Bilateral blade configuration

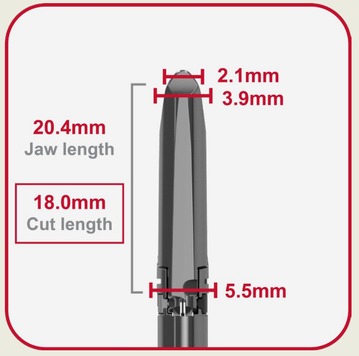


Found on some advanced bipolar devices.

Advanced bipolar[5]



ENSEAL™ X1 Curved Jaw



ENSEAL™ X1 Straight Jaw

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Manage large bleeder / vessel

Back to matrix

Advantage: ☐ Minor ☑ Moderate ☐ Strong

Advanced bipolar

Clinical examples & considerations

Good forceps to manipulate tissues safely and avoid further damage are mandatory. Advanced bipolar has a similar design to the Maryland dissector and allows the vessel to be gripped and sealed in stages, enabling grip correction and immediate energy application.

Ultrasonic technology

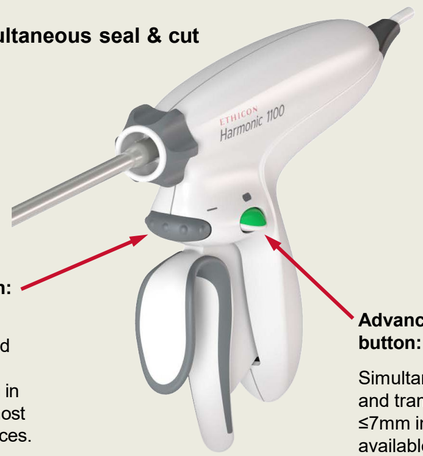
Advantages

- HARMONIC™ 1100 Shears is indicated for the coagulation of vessels, up to and including 7 mm in diameter, using the Energy button with Advanced Hemostasis[12,13]

Trade-offs

- Requires there be enough of a stump to grasp.
- Activating in a pool of blood can reduce the coagulation effect (i.e., blood serves as a heat sink) which may result in an incomplete seal.
- Somewhat technique dependent due to simultaneous coagulation and cut if attempting to coagulate without cutting.

Simultaneous seal & cut



Harmonic™ 1100 Shears[4]

Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Advanced bipolar technology

Advantages

- Separate seal & cut capabilities[9]
  - provides options for multiple activations without transecting and making the vessel shorter in length.
- Overall jaw width and sealing electrode wider than ultrasonic blade, allowing for more tissue to be grasped and sealed (varies by manufacturer).

Trade-offs

- Requires there be enough of a stump to grasp.
- Activating in a pool of blood can reduce the coagulation effect (i.e., blood serves as a heat sink) which may result in an incomplete seal.

Separate seal & cut[9]

Energy button:

Seal only or vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Wider sealing area due to electrode width

ENSEAL™ X1 Curved Jaw[5]

ENSEAL™ X1 Straight Jaw[5]

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Spot coagulate small bleeder

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Advanced bipolar

Clinical examples & considerations

The immediate action is mechanical compression of the structure to control bleeding, followed by the use of energy.

Ultrasonic technology

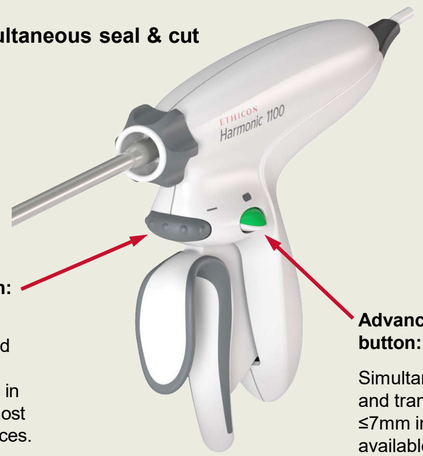
Advantages

- Can spot coagulate with just the active blade or by grasping and activating.

Trade-offs

- Requires there be enough tissue / stump to grasp when using the clamp arm.
- Somewhat technique dependent when using just the active blade (i.e., no clamp arm).

Simultaneous seal & cut



Harmonic™ 1100 Shears [4]

Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Advanced bipolar technology

Advantages

- Separate seal capability provides options for multiple activations without transecting and making the vessel shorter in length.
- Overall jaw width and sealing electrode wider than ultrasonic blade, allowing for more tissue to be grasped and sealed (varies by manufacturer).

Trade-offs

- Requires there be enough of a stump to grasp.

Separate seal & cut

Energy button:

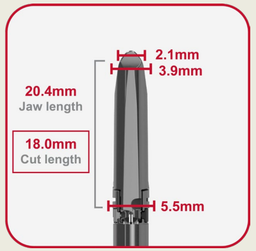
Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Wider sealing area due to electrode width

ENSEAL™ X1 Curved Jaw [5]



ENSEAL™ X1 Straight Jaw [5]

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Seal medium to large and / or “named” vessels (5-7mm in diameter)

Back to matrix

Advantage: NONE - modalities are equal

Ultrasonic = Advanced bipolar

Clinical examples & considerations

Sealing and cutting a large, or named, vessel can be a tense moment due to inherent risks. Anxiety & severity depend on the surgeon's experience in dealing with complications. Using energy requires confidence in the method & gradual adoption.

Both modalities are proven to be effective for sealing vessels up to & including 7mm in diameter.

Ultrasonic technology

Advantages

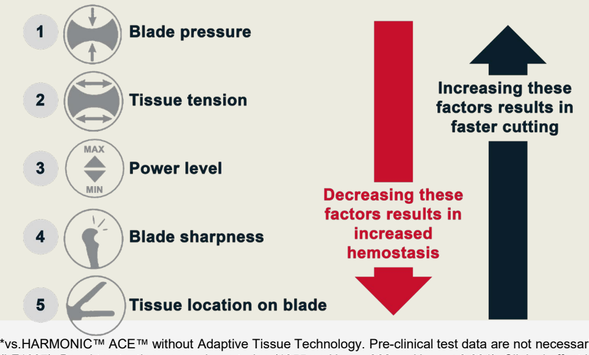
- Most device manufacturers utilize a mechanical-based impedance algorithm to achieve sealing hemostasis.
- Seal vessels with strong burst pressures.

Trade-offs

- Technique dependent: Tension (anatomical or from grasping/retraction) should be reduced to enable a greater hemostatic effect.
- Vessel should be fully captured and placed in the center of the blade to optimize sealing.
- Requires a lower generator setting and / or an advanced algorithm to enable the needed hemostatic effect.
- Very few manufacturers offer an ultrasonic device with a 7mm vessel indication.

Science of Energy

5 ways surgeons can increase hemostasis with ultrasonic



Simultaneous seal & cut

Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Adaptive Tissue Technology works with the GEN11 to provide enhanced feedback, enabling more precise energy delivery and improved temperature management[6-8*]. The generator and device work together to:

- Sense impedance (advanced bipolar: electrical, ultrasonic: mechanical)
- Optimize energy delivery based on changing tissue conditions
- Enable larger vessel sealing capabilities[9]
- Adaptive Tissue Technology is actively managing and improving the thermal profile of the device[9,10]
- Enable a lower thermal profile vs. devices without adaptive controls

*vs.HARMONIC™ ACE™ without Adaptive Tissue Technology. Pre-clinical test data are not necessarily indicative of clinical performance. †Comparison of ENSEAL X1 Curved Jaw to LigaSure™ Maryland (LF1937). Benchtop testing on porcine arteries (1055mmHg vs. 862mmHg, p < 0.001). Clinical effect is unknown.

Advanced bipolar technology

Advantages

- Tension (anatomical or from grasping/retraction) does not impact the hemostatic effect, although excessive tension can be an issue.
- Vessel placement in the jaws not as critical as with ultrasonic.
- Separate or unique energy button not required..
- Most, if not all, advanced bipolar devices are indicated to seal ≤7mm vessels[11]
- Stronger Sealing Capabilities[11*]

Trade-offs

- Requires a minimum of 2 steps: energy delivery, followed by transection with knife.

Separate seal & cut[9]

Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Seal small and / or “named” vessels (1-5mm in diameter)

Back to matrix

Advantage: NONE - modalities are equal

Ultrasonic = Advanced bipolar

Clinical examples & considerations

Sealing and cutting a large, or named, vessel can be a tense moment due to inherent risks. Anxiety & severity depend on the surgeon's experience in dealing with complications. Using energy requires confidence in the method & gradual adoption.

Both modalities are proven to be effective for sealing vessels up to & including 7mm in diameter.

Ultrasonic technology

Advantages

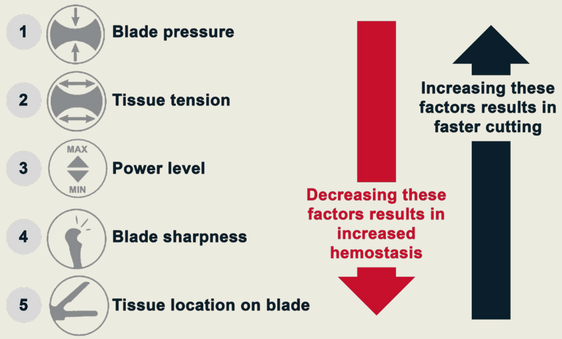
- Most ultrasonic devices are indicated to seal vessels ≤5mm in diameter (there are some manufacturers with ≤7mm vessel indication).
- Simultaneous coagulation and cut (enables efficiency).
- Seal vessels with strong burst pressures.

Trade-offs

- Tension (anatomical or from grasping/retraction) should be reduced to enable a greater hemostatic effect.
- Vessel should be fully captured and placed in the center of the blade to optimize sealing.

Science of Energy

5 ways surgeons can increase hemostasis with ultrasonic



Advanced bipolar technology

Advantages

- Tension (anatomical or from grasping/retraction) does not impact the hemostatic effect, although excessive tension can be an issue.
- Vessel placement in the jaws not as critical as with ultrasonic.
- Seal vessels with strong burst pressures.

Trade-offs

- Requires a minimum of 2 steps: Energy delivery, followed by transection with knife.

Simultaneous seal & cut

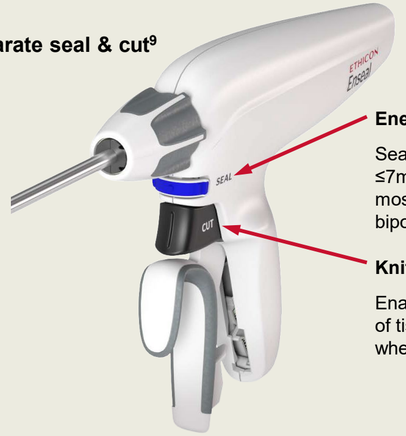
Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Separate seal & cut[9]



Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Seal only

Back to matrix

Advantage: ☐ Minor ☐ Moderate ☑ Strong

Advanced bipolar

Clinical examples & considerations

By reproducing the conventional ligation technique, this may be the first step for a surgeon to learn how to use advanced bipolar, especially on small vessels.

Ultrasonic technology

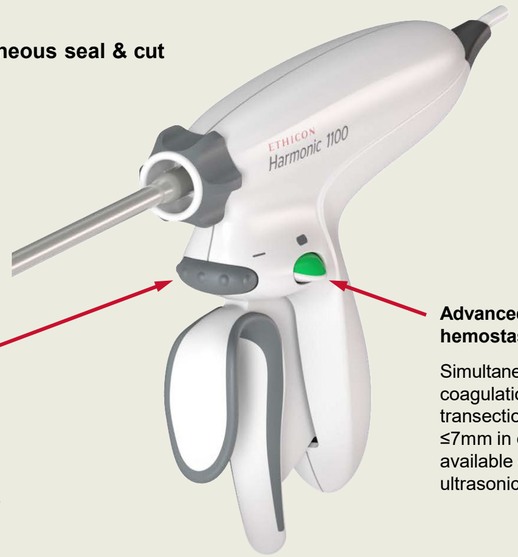
Advantages

- While very technique dependent, expert users can achieve seal only with ultrasonic devices by clamping and delivering energy for a brief period.

Trade-offs

- Ultrasonic devices are designed to simultaneously coagulate and cut.

Simultaneous seal & cut



Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Advanced bipolar technology

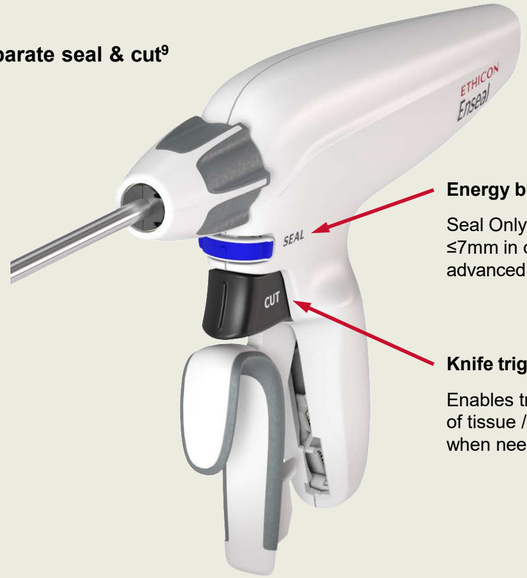
Advantages

- Advanced bipolar devices provide separate seal and cut capabilities[9].

Trade-offs

- N/A

Separate seal & cut[9]



Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Seal vessel bundles

Back to matrix

Advantage: ☐ Minor ☑ Moderate ☐ Strong

Advanced bipolar

Clinical examples & considerations

Sealing and cutting bundles is the most common form of hemostasis and transection. Generally, the bundle consists of an artery, vein and lymphatic system surrounded by connective tissue.

Ultrasonic technology

Advantages

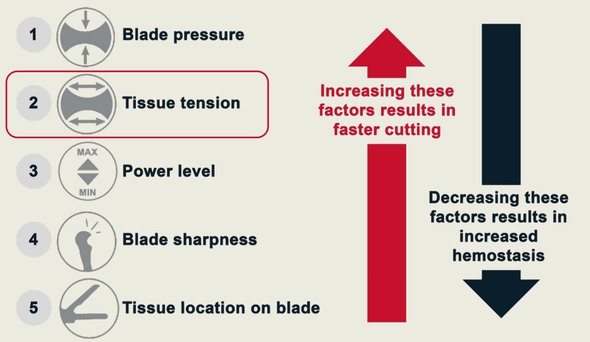
- Simultaneous coagulation and cut (enables efficiency).

Trade-offs

- Diameter of bundle will dictate the energy button utilized (e.g., min, max, advanced hemostasis, etc.).
- Overall jaw length typically not as long as advanced bipolar devices (varies by manufacturer).
- Tension (anatomical or from grasping / retraction) should be reduced to enable a greater hemostatic effect.
- Vessel(s) in the bundle should be fully captured and placed in the center of the blade to optimize sealing.

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic



Harmonic™ 1100 Shears[4]

Advantages

- Overall jaw width and sealing electrode typically wider than ultrasonic blade, allowing for more tissue to be grasped and sealed (varies by manufacturer).
- Tension (anatomical or from grasping / retraction) does not impact the hemostatic effect, although excessive tension can be an issue.
- Less technique dependent (separate or unique energy button not required).
  - Tissue bundle placement not as critical as with ultrasonic.

Trade-offs

- Requires a minimum of 2 steps: energy delivery, followed by transection with knife.

Separate seal & cut

Energy button:

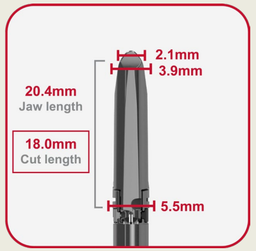
Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Wider sealing area due to electrode width

ENSEAL™ X1 Curved Jaw[5]



ENSEAL™ X1 Straight Jaw[5]

Advanced bipolar technology

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Seal vessels that are under tension (i.e., anatomical or tension from retraction)

Back to matrix

Advantage: ☐ Minor ☐ Moderate ☑ Strong

Advanced bipolar

Clinical examples & considerations

Naturally, the vascular pedicle retracts, making it challenging to localize & control bleeding in this situation. The use of ultrasonic in short vessels (gastrectomy, sleeve, fundoplication, splenectomy), duodenal- pancreatic vessels, thyroid vessels & pulmonary hilum vessels can be a challenge for surgeons inexperienced with this energy.

Ultrasonic technology

Advantages

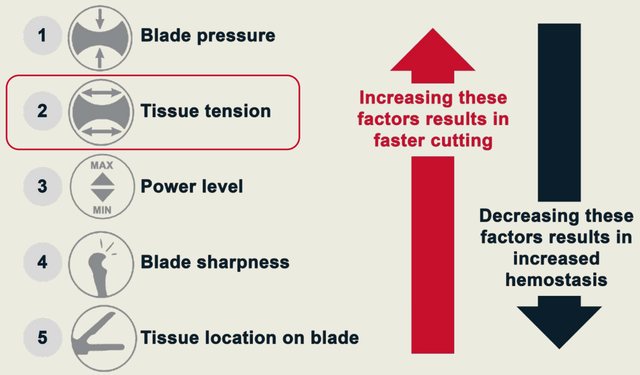
- Simultaneous coagulation and cut (enables efficiency).

Trade-offs

- Tension increases the cutting effect with ultrasonic technology, thereby reducing the hemostatic effect desired to seal a vessel.
- Potentially achievable by reducing tension (as able to do so) and lowering the generator power setting to enable more of a hemostatic effect versus a cutting effect.
- Targeted vessel should be exposed enough to ensure that it is accessible after transection should there be an incomplete seal (risk of vessel retracting and not easily accessible).

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic



Advanced bipolar technology

Advantages

Tension (anatomical or from grasping / retraction) does not impact the hemostatic effect, although excessive tension can be an issue.

Trade-offs

- Requires a minimum of 2 steps: energy delivery, followed by transection with knife.
- Targeted vessel should be exposed enough to ensure that it is accessible after transection should there be an incomplete seal (risk of vessel retracting and not easily accessible).

Separate seal & cut[9]

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Backscoring (e.g., cutting or marking the area for resection)

Back to matrix

Unique capability for

Ultrasonic

Clinical examples & considerations

This feature reproduces monopolar effects and can be used to demarcate different tissues for dissection. Peritoneum (inguinal or incisional hernia repair), mesentery (colectomy, enterectomy), partial resection of the liver, kidney, or lung.

Ultrasonic technology

Advantages

- Simultaneous coagulation and cut allows the surgeon to drag the active blade across the tissue (without engaging the clamp arm).
- Increasing device pressure against the tissue enables deeper cutting with the active blade.

Trade-offs

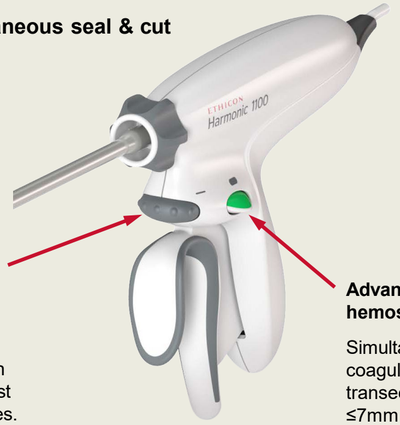
- Blade heat and heat retention can be a concern.

Ultrasonic devices are unique in their ability to simultaneously coagulate and cut, and provide the ability to use the active blade to cut without grasping.

UNIQUE TO ULTRASONIC:

Using the back of the active blade to coagulate and cut tissue.

Simultaneous seal & cut



Energy button:

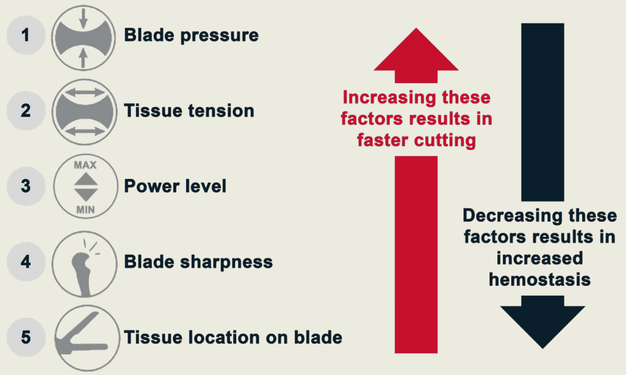
Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic



Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Otomy creation ("drilling")

Back to matrix

Advantage: ☐ Minor ☐ Moderate ☑ Strong

Ultrasonic

Clinical examples & considerations

Reproduces monopolar effect by creating a hole for inserting the stapler or tubes.

Examples include a variety of intestinal diversion with side-to-side anastomoses: gastro-entero, entero-entero, entero-colic, etc.

Ultrasonic technology

Advantages

- Simultaneous coagulation and cut allows the surgeon to push the distal tip of the active blade into anatomy with a lumen (without engaging the clamp arm).

Trade-offs

- Blade heat and heat retention can be a concern.
- Care should be taken to not penetrate underlying anatomy/structure.

Ultrasonic devices are unique in their ability to simultaneously coagulate and cut, making them more efficient.

Using the tip of the active blade to create an otomy

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic

1. Blade pressure
2. Tissue tension
3. Power level (MAX / MIN)
4. Blade sharpness
5. Tissue location on blade

Increasing these factors results in faster cutting

Decreasing these factors results in increased hemostasis

Advantages

- Otomy can be created, but not as efficiently as with ultrasonic.

Trade-offs

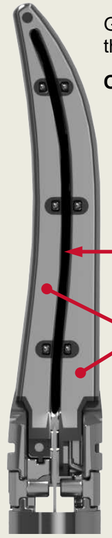
- Otomy creation without energy may result in oozing.
- Requires a minimum of 2 steps: Energy delivery, followed by transection with knife.
- Does not cut to the distal tip (knife stops at ~1-2mm before tip), requiring surgeon to grasp more tissue/cause more damage.

Otomy creation on avascular tissue

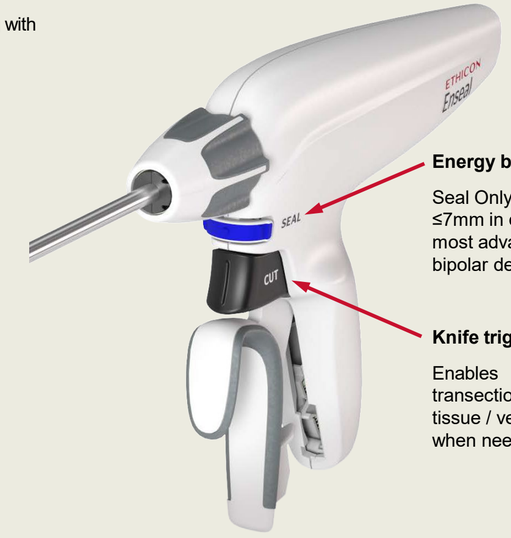
Grasp enough tissue to enable cutting with the knife blade.

Otomy creation on vascular tissue

1. Grasp tissue
2. Deliver energy
3. Cut with the knife blade



Separate seal & cut[9]



Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Advanced bipolar technology

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Marching through tissue (e.g., parenchyma, mesentery, etc.)

Back to matrix

Advantage: ☑ Minor ☐ Moderate ☐ Strong

Ultrasonic

Clinical examples & considerations

Especially applicable in abdominal surgeries on releasing large areas. Ultrasonic can be as fast as scissors, but with hemostasis.

Colorectal: Colonic detachment, omentectomy, mesentery dissection **Gynecology:** Total abdominal hysterectomy (TAH), debulking in ovarian cancer

Ultrasonic technology

Advantages

- Simultaneous coagulation and cut (enables efficiency).
- Adding device pressure, tissue tension, and increasing the generator power level to the highest setting optimizes cutting effect.
- Transects tissue to the distal tip.

Trade-offs

- Blade heat and heat retention can be a concern.
- Marching through vessels can be an issue if vessel is not fully captured or if trying to go fast (i.e., maximizing cutting vs. hemostasis) and may result in oozing or bleeding.

Ultrasonic devices are unique in their ability to simultaneously coagulate and cut, making them more efficient.

Science of Energy

5 ways surgeons can cut & dissect faster with ultrasonic

1. Blade pressure
2. Tissue tension
3. Power level (MAX / MIN)
4. Blade sharpness
5. Tissue location on blade

Increasing these factors results in faster cutting

Decreasing these factors results in increased hemostasis

Advanced bipolar technology

Advantages

- Marching through avascular tissue can be achieved efficiently with the mechanical knife.
- Seals tissue to the distal tip (beyond the cut line) which can be beneficial if a vessel is not fully captured.
- Overall jaw length typically wider than ultrasonic blade, allowing for more tissue to be sealed and cut (varies by manufacturer).

Trade-offs

- When using energy, requires 2 steps (energy delivery, followed by transection with knife).
- Does not cut to the distal tip (knife stops at ~1-2mm before tip), requiring surgeon to grasp more tissue/cause more damage.

Seals tissue to the distal tip (beyond the cut line), which can be beneficial if a vessel is not fully captured.

Separate seal & cut[9]

Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables transection of tissue / vessels when needed.

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Transect tissue or vessel with energy

Back to matrix

Unique capability for

Ultrasonic

Clinical examples & considerations

Especially applicable in abdominal surgeries on releasing large areas. Ultrasonic can be as fast as scissors, but with hemostasis.

Colorectal: Colonic detachment, omentectomy, mesentery dissection **Gynecology:** Total abdominal hysterectomy (TAH), debulking in ovarian cancer

Ultrasonic technology

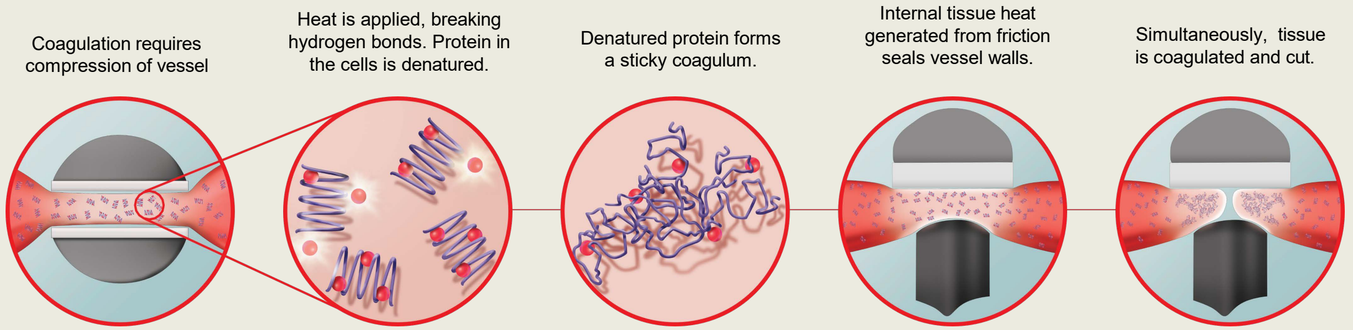
Advantages

- Simultaneous coagulation & cut with energy is a hallmark feature of ultrasonic technology.

Trade-offs

- N/A

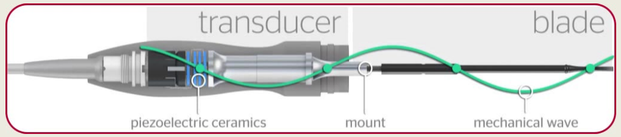
Science of Energy - Ultrasonic coagulation process



Science of energy - How frictional heat is created

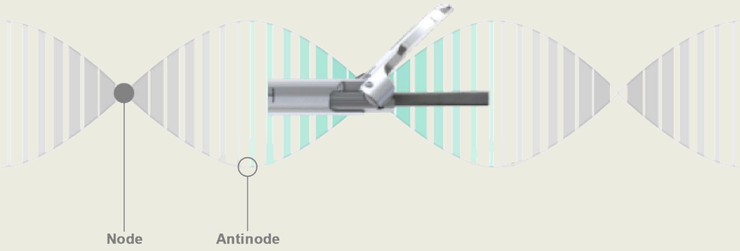
Converting electrical energy to mechanical motion

Electrical energy from the generator is converted to mechanical motion in the hand piece transducer. This movement cycles 50,000 to 55,500 times per second to create frictional heat when in contact with tissue.



Expansion and contraction of the blade

The mechanical wave travels down the entire length of the blade, causing the titanium shaft to expand and contract in between the nodes. The greatest displacement occurs at the antinodes. Note that the distal tip is designed to be at an antinode.



Distal tip displacement

~50 µm at Power Level 1
~100 µm at Power Level 55

1,000µm = 1mm

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

Transect tissue without energy (“cold cut”)

Back to matrix

Unique capability for

Advanced bipolar

Clinical examples & considerations

This reproduces the dissection accomplished with scissors in avascular tissues.

Advantages

- Allows mechanical transection of tissue with knife blade.

Trade-offs

- N/A

Simultaneous seal & cut

No ability to "cut only" with ultrasonic.

Energy button:

Simultaneous coagulation and transection for vessels ≤5mm in diameter for most ultrasonic devices.

Advanced hemostasis button:

Simultaneous coagulation and transection for vessels ≤7mm in diameter (not available on most ultrasonic devices).

Separate seal & cut[9]

Energy button:

Seal Only for vessels ≤7mm in diameter for most advanced bipolar devices.

Knife trigger:

Enables “cold cutting” of avascular tissue

Advanced bipolar technology

Key differentiating advantage(s).

Note: These are general guidelines. Each surgeon and situation is unique.

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